way. It is too soon to expect clear-cut conclusions in regard to these questions. But many will agree with the author in regard to the following three points. (1) There is in instinctive behaviour a psychical awareness as well as a physiological concatenation. "One can hardly see in insects simple reflex machines, for they know how to bend to circumstances, to acquire new habits, to learn and to retain, to show discernment. They are, one can say, somnambulists whose minds awaken and give proof of intellect when there is need for it. This takes us a long distance from the mechanism of which Bethe has made himself a protagonist." (2) Whether a capacity for novel instinctive behaviour originated from a sudden mutation or as the outcome of a more or less slow modification of habit, there must always be a period of individual apprenticeship, when the new card is played, or when the new adjustment is tested for what it is worth. (3) The climax of instinctive behaviour among arthropods is correlated with their characteristic organisation—a non-living armature of chitin with the musculature inside, not outside, and a considerable number of specialised appendages, which must be used in one way and in no other. "The appendages of Arthropods are nearly unchangeable in the individual and are narrowly adapted to certain purposes; they are the tools for instinctive work, thus differing from the less specialised but more supple limbs that serve as implements to the vertebrates, at least to the higher vertebrates." The contrast between a bee's specialised proboscis and a man's generalised hand is diagrammatic. So from the beginning, as Bergson also suggested, insects "were bound to use these organic tools, and they made the best use of them. Their main psychical task was to grave upon their memory and to repeat instinctively the acts to which these organs were fitted."

The fundamental part of Bouvier's masterly book is devoted to the analysis of the inclined plane of insect behaviour. He goes on to special problems such as the relation of insects to flowers, the faculty of orientation, the social life of insects, and the division of labour in nest-making Hymenoptera. Apart from a few slips, the translation, which cannot have been easy, is an effective piece of work.

Chemistry of the Plant Cell.

Chemie der Pflanzenzelle. By Prof. Dr. Victor Grafe. Pp. viii + 421. (Berlin: Gebrüder Borntraeger, 1922.) 105 marks.

THE title of this book raises immediately the interesting question as to whether the chemistry of the plant cell can yet be made the subject of a text-book. A perusal of this book leaves no doubt that such a work has still to be written. There are many interesting pages, but the book is in no sense an introduction to the special chemical metabolism proceeding within the plant cell.

The author treats his subject mainly from the point of view of physical chemistry, and the reader must, if the book is to be read with profit, be very thoroughly grounded in organic chemistry and bio-chemistry. Thus an interesting section on the cell wall, and a final subsection dealing with the chemistry of photosynthesis, are not accompanied by any discussion of the chemistry of the carbohydrates. Again, in a section of some 150 pages under the general title of protoplasm, ten pages only are assigned to the chemistry of lipoids (fats, phosphatides, sterols, etc.), proteins and nucleo-proteins; the same section closes with a subsection of some thirty pages, devoted to the pigments of the plant, which deal mainly with the recent researches of Willstätter upon the leaf pigments and the anthocyanins.

Lack of proportion is manifest throughout the book, and is accompanied by a lack of arrangement which leads to much tedious repetition. The main topics, diffusion, osmosis, plasma permeability, colloids, and adsorption, with which the book opens, recur again and again throughout its pages. Thus a later subsection headed plasma structure, in the section upon protoplasm, consists mainly of a rediscussion of the phenomena of plasmolysis and permeability. Undoubtedly these topics are of primary importance in a work upon plant physiology, but it is doubtful whether their significance in this field will be better apprehended as a result of the study of this book. The discussion of the physical chemistry of these complex phenomena is far too brief and inadequate to form a sound critical basis for their subsequent application to the still more complex problems of the living cell.

To cite specific cases: the first examples of adsorption phenomena dealt with, freely assume the specific adsorption of one ion from the solution of an electrolyte with consequent change in the reaction of the solution. The work of Baumann and Gully, and of Wieler, is cited in this connexion, and only upon a later recurrence of the topic is Sven Oden referred to in a footnote. Reference to Sven Oden's papers will show how unsound is the experimental basis for this assumption of specific ionic adsorption, while recent discussions by Bancroft ("Applied Colloid Chemistry," 1921) and E. A. Fisher ("Physico-Chemical Problems relating to the Soil," Faraday Society, 1922) show how inadequate are discussions of adsorption phenomena, based, as this one is, upon the application of Gibb's theorem

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without further reference to the chemical questions involved.

Again, a brief discussion of the Liesegang rings obtained when silver nitrate diffuses into gelatin containing potassium bichromate (p. 43), is made the starting-point for many suggestions as to the significance of these phenomena in explaining stratification in structural features of the cell and even of tissues. In view of our lack of information as to these diffusion phenomena, little significance can attach at present to the analogous appearances in cell structures referred to by the author.

The physical properties of protein sols and gels are discussed without reference to the reaction of the solution or the iso-electric point of the protein, the fundamental papers published by Jacques Loeb being ignored. Swelling and imbibition remain, therefore, very incompletely treated, and the interesting American work upon the importance of pentosans in the retention of water by plant mucilages is also neglected. The author refers, however, in his preface to the continued post-war difficulty in obtaining access to foreign literature, and doubtless these sections will undergo modification in a later edition.

The subsection upon enzyme action shows a similar lack of arrangement. It is to be hoped that the author's endorsement of Euler's suggestion that when enzymes are active as catalysts during synthesis they should be denoted by the suffix "*ese*," will not lead to an extension of the practice. His discussion of enzymes in relation to metabolic synthesis is unsatisfactory, but it at least makes clear how little reason there is for such a practice. Without a clear discussion of modern views of the stereo-chemistry of the hexoses, the discussion of the catalytic action of maltase and emulsin during synthesis is necessarily difficult, but it is curious to find no mention of the experiments of Bourquelot and Bridel, which had reached an interesting stage even in pre-war days. An interesting discussion of the action of hormones in relation to stimulus and response appears in this subsection upon enzymes. The subject reappears in a later section under the heading of response to stimulus, and here reference is made to the work of Paal, Ricca, and others, the absence of which in the earlier discussion had aroused surprise.

The attempt made to base the phenomena of stimulus and response upon physico-chemical phenomena provides some of the most interesting reading of the book, but it would appear hopeless to expect success in such an effort when the subject of the quantitative study of growth rate is compressed into less than two pages at the end of this section.

Scientific Management of Farming.

(1) *Farm Management: A Text-book for Student, Investigator, and Investor.* By Prof. R. L. Adams. (Agricultural and Biological Publications.) Pp. xx+671. (New York and London: McGraw-Hill Book Co., Inc., 1921.) 20*s.*

(2) *Organised Produce Markets.* By Prof. John George Smith. Pp. ix+238. (London: Longmans, Green and Co., 1922.) 12*s.* 6*d.* net.

(3) *Agricultural Co-operation in England and Wales.* By W. H. Warman. Pp. xi+204. (London: Williams and Norgate, 1922.) 5*s.* net.

(4) *Rural Organization.* By Prof. W. Burr. Pp. xiv+250. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1921.) 12*s.* net.

THE volumes before us emphasise the fact that farming involves two distinct kinds of operation, the production of crops and animals, and the marketing of the resulting commodities. Scientific investigators have in the past confined themselves almost exclusively to production, this being the side that involves the soil, the growing plant and the living animal, and with these almost all the sciences at present studied; it is quite evident, however, that there is a wide field for the economist in the marketing problems that will amply repay study.

(1) Prof. R. L. Adams deals exclusively with American conditions; his book is of a type that is not produced in this country, the old Fream in the past and some of the Oxford publications in the present being our nearest approach to it. It covers the whole range of the farm activities, largely from the economic side, but with constant references to modern improvements in production and the scientific principles on which they are based.

A great advantage of the book is the generous provision of tables of data showing crop yields, costs of production, effects of various factors on costs, on income, etc., with references to the original sources which will be at least equally appreciated. It is these data and references which give the book a special value to the teacher in this country, for he is thus enabled to ascertain how the values have been arrived at and how far they can help him in his work.

(2) Prof. J. G. Smith, of the Faculty of Commerce in the University of Birmingham, sets out in his book the general characteristics of organised markets and the broad principles involved in marketing operations. Considerable space is devoted to wheat and large-scale buying operations are discussed in detail. The volume is of interest as showing the extraordinary complexity of the processes whereby wheat is transferred from the Canadian farm to the English consumer.

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